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Seasonal incidence of cone pests of Black Spruce in Newfoundland

R.J. West

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SEASONAL INCIDENCE OF CONE PESTS OF BLACK SPRUCE IN NEWFOUNDLAND

by R.J. West

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ABSTRACT

Intensive studies were conducted from June to September 1984 in western Newfoundland to determine the seasonal incidence of factors damaging to black spruce cone crops. In June, cones were severely damaged by frost and externally feeding Lepidoptera caused additional damage. In July damage was light and caused primarily by Lepidoptera, particularly the cone moth, Archips alberta (McD.), and the spruce cone maggot, Hylemya anthracina (Czerny). In August and September, cone losses were severe and caused mainly by the red squirrel, Tamiasciurus hudsonicus (Erxleben).

RÉSUMÉ

De juin à septembre 1984, des études intensives ont été effectuées dans l'ouest de Terre-Neuve afin de déterminer l'incidence saisonnière des facteurs causant des dommages aux cônes de l'épinette noire. En juin, les cônes ont subi des dommages sévères par le gel, et des lépidoptères attaquant la partie externe des cônes ont causé des dommages additionnels. En juillet, les dommages ont été faibles, les principaux responsables étant des lépidoptères, notamment Archips alberta (McD.) et la mouche granivore de l'épinette (Hylemya anthracina (Czerny)). En août et en septembre, les pertes ont été très importantes et ont été infligées principalement par l'écureuil roux (Tamiasciurus hudsonicus (Erxleben)).

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SEASONAL DAMAGE TO BLACK SPRUCE CONE CROPS IN NEWFOUNDLAND

by

R.J. West

INTRODUCTION

Expanding reforestation programs in Newfoundland have led to increased demands for conifer seed, yet few studies examining factors detrimental to cone crops have been conducted in this Province. Published information includes the effect of the spruce budworm, Choristoneura fumiferana (Clem.), on cone production by balsam fir (Schooley 1978) and black spruce (Schooley 1980) and the reduction of natural storage of black spruce seed by the cone beetle, Ernobius sp. (Schooley 1982). Consequently, further studies are urgently needed to identify other damaging factors, quantify the damage caused by various agents and develop sound guidelines for cone management. This report summarizes the results of intensive studies determining the seasonal incidence of cone pests of black spruce in western Newfoundland.

METHODS

1. Bi-weekly Collections

Current Year Cones - Cones were collected at two-week intervals from the time of bud break in early June to the end of August, when cones mature, from thinned black spruce stands near Burntberry Pond (49°27'N, 56°09'W), Cormack (49°22'N, 57°18'W) and Taylor's Brook (49°32'N, 57°04'W). Samples of 25 cones were removed arbitrarily from each of 30

trees for each collection. Trees were approximately 4 ± 0.5 m in height and sampled only once. Aborted, frost-killed cones[1] were not sampled. Individual cones were examined for external damage, then bisected longitudinally to determine internal injury.

Lepidoptera found on cones were identified using the key of Lindquist (1982). Species of other insect orders were identified using keys and descriptions of Hedlin et al. (1981) and Ruth et al. (1982). Nomenclature follows that of Benoit (1985).

Old Cones - Ten cones, about three to four years old, were collected from each of 30 trees at the intervals and locations described above. However, few old cones remained on trees at Burntberry Pond and collections there ceased on June 26. Cones were bisected and examined for the presence of the cone beetle.

2. Cone Life Study

All cone-bearing branches on 15 trees, 4 ± 0.5 m in height, at the Taylor's Brook site were tagged on June 8 and the number of conelets counted. Thereafter, cones were examined for external damage at two-week intervals until September 5. Damaged cones were marked with coloured wire and the number of sound cones remaining at the end of each interval recorded.

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[1]Cones assessed as frost-damaged were under 15 mm in length, brown to purplish-brown in colour and remained open after undamaged cones had closed.

RESULTS

1. Bi-weekly Collections

Current Year Cones (Table 1).

a) External Feeders

i. Lepidoptera

External feeding by Lepidoptera was heaviest in mid-June and at the end of August. The decline in the number of injured cones in late June and July suggests that some cones which would have been counted as injured in mid-June had recovered by mid-summer. Damage by individual species was not quantified; however, species attacking cones included the orange spruce needleminer, Coleotechnites piceaella (Kearfott), in June and July, the spruce budworm and spruce coneworm, Dioryctria reniculelloides Muturra and Munroe, in June and July; the cone moth, Endopiza piceana (Free.), in July and August; and the fir coneworm, D. abietivorella (Grote), in late August.

b) Internal Feeders

i. Spruce cone Maggot, Delia anthracina (Czerny)

The spruce cone maggot did not occur in significant numbers until July. At each location the percentage of damaged cones varied between trees sampled on the same date suggesting that the distribution of the cone maggot is patchy in natural stands. This suggestion is strengthened by noting the discrepancy in the percentage of damaged cones collected at different dates. Taking the Burntberry Pond site as an example, the percentage of damaged cones collected on July 24 was 15.2,

Table 1. Mean percentage (± S.E.) of current year, black spruce cones damaged per tree by insects at Burntberry Pond, Cormack and Taylor's Brook, Newfoundland, June-August 1984. Twenty-five cones from each of 30 trees were examined for each location and date of collection.

1. Burntberry Pond

Cause of damage	Date of Collection						
	15-VI	26-VI	11-VII	24-VII	6-VIII	16-VIII	29-VIII
a) External:							
Lepidoptera	12.5 ± 1.8	6.8 ± 2.1	2.3 ± 0.6	0.7 ± 0.3	0.9 ± 0.5	11.1 ± 2.9	19.7 ± 3.4
b) Internal:							
Spruce cone maggot	-	-	10.3 ± 2.1	15.2 ± 2.1	3.7 ± 0.8	5.7 ± 1.4	6.4 ± 1.3
Spruce cone axis midge	-	-	-	-	-	-	-
Spruce seedworm	-	-	-	-	-	-	-
Cone resin midge	-	-	-	-	-	-	-
Coneworm	0.1*	-	-	-	-	-	-
Spruce budworm	-	0.1*	-	-	-	-	-
Seed midge	-	-	-	-	-	-	-

*Only one cone attacked.

.../Cont'd.

2. Cormack (Cont'd.)

Cause of damage	Date of Collection						
	13-VI	25-VI	9-VII	23-VII	9-VIII	20-VIII	28-VIII
a) External:							
Lepidoptera	13.1 ± 1.4	5.9 ± 1.2	3.7 ± 0.9	7.6 ± 2.1	0.6 ± 0.3	17.7 ± 2.2	24.3 ± 3.1
b) Internal:							
Spruce cone maggot	-	-	2.4 ± 0.6	7.7 ± 1.6	4.4 ± 1.0	2.1 ± 0.6	6.3 ± 1.6
Spruce cone axis midge	-	-	-	-	0.3**	2.9 ± 1.3	6.8 ± 1.8
Spruce seedworm	-	-	-	0.3**	-	0.7 ± 0.4	0.8 ± 0.3
Cone resin midge	-	-	-	0.1*	-	0.5 ± 0.3	0.1*
Coneworm	0.1*	-	-	-	-	-	1.3 ± 0.5
Spruce budworm	-	-	-	-	-	-	-
Seed midge	-	-	-	-	-	-	1.3 ± 0.6

*Only one cone attacked.

**Two cones on one tree attacked.

.../Cont'd.

3. Taylor's Brook (Concl'd.)

Cause of damage	Date of Collection						
	12-VI	20-VI	10-VII	25-VII	3-VIII	15-VIII	27-VIII
a) External:							
Lepidoptera	24.4 ± 2.8	10.7 ± 1.6	10.9 ± 1.6	2.8 ± 0.7	6.2 ± 2.0	31.5 ± 3.5	43.5 ± 3.7
b) Internal:							
Spruce cone maggot	-	0.3 ± 0.2	5.7 ± 1.0	7.1 ± 1.5	6.1 ± 1.8	6.0 ± 1.1	4.9 ± 1.2
Spruce cone axis midge	-	-	0.1*	-	2.5 ± 1.2	7.6 ± 2.3	10.4 ± 2.7
Spruce seedworm	-	-	-	-	0.4***	1.1 ± 0.7	1.2 ± 0.4
Cone resin midge	-	-	-	-	0.3**	1.6 ± 0.6	0.8 ± 0.4
Coneworm	0.4 ± 0.3	-	-	-	-	-	0.1*
Spruce budworm	0.9 ± 0.4	-	-	0.1*	-	-	-
Seed midge	-	-	-	-	-	-	-

*Only one cone attacked.

**Two cones on one tree attacked.

***Three cones on one tree attacked.

yet on August 6, only 3.7% of cones collected were damaged. This decline would be unexpected if the distribution of this insect was uniform in the stand because damage caused by the cone maggot is permanent. Cones vacated by the maggot were first observed at the end of July and no cones contained live maggots after mid-August indicating that cone exits occurred during this period.

Cones attacked by the spruce cone maggot were generally smaller and had a substantial number of seeds destroyed.

ii. Spruce Cone Axis Midge, Dasineura rachiphaga Tripp

Larvae were first found in samples at Taylor's Brook on July 10, however, the majority of cones containing the midge were not collected until the end of August. D. rachiphaga was not observed in cones collected from Burntberry Pond.

Two stages of the midge life cycle were observed. Before mid-August, all midges observed were as naked larvae in chambers within the cone axis and at the base of bracts. After mid-August, an increasing number of larvae in overwintering cocoons were observed. By the end of August, all healthy larvae had spun cocoons.

The number of midge larvae or cocoons found per cone averaged two and ranged from one to six. No damage to seeds was apparent.

iii. Spruce Seedworm, Cydia strobilella (L.)

Larvae were first found at the end of July at Cormack and in early August at Taylor's Brook but were not present in cones collected from Burntberry Pond.

The average percentage of cones containing C. strobilella was low at Cormack and Taylor's Brook. Several attacked cones were also damaged by the cone maggot.

In attacked cones an undetermined number of seeds were destroyed.

iv. Cone Resin Midge, Resseliella sp.

Cone resin midge larvae were found in cones collected at Cormack and Taylor's Brook but not Burntberry Pond. Midge-infested cones were first observed in cones collected on July 23 at Cormack and August 3 at Taylor's Brook. With the exception of cones collected at Taylor's Brook on August 15, the average percentage of cones infested per tree was less than 1.0%. Although as many as six larvae were found in one cone, there was no apparent damage to seeds.

v. Spruce Coneworm, Dioryctria reniculelloides Muturra and Munroe; and fir coneworm, D. abietivorella (Grt.)

Cones internally damaged by the spruce coneworm were occasionally found at all three sites in mid-June. A damaged cone containing an empty pupal case was found at Taylor's Brook on August 27 and at Cormack on August 28.

Cones damaged by, and in some cases bearing larva of, the fir coneworm were found at a low incidence at Cormack on August 28.

In cones attacked internally by either coneworm species, damage to seeds was extensive.

vi. Spruce Budworm, Choristoneura fumiferana (Clem.)

A small percentage of cones internally damaged by budworm feeding were collected at Burntberry Pond and Taylor's Brook. Larvae were found feeding in cones in June.

Seed loss in cones internally attacked by the budworm was appreciable.

vii. Seed Midge (undetermined species)

A low percentage of cones collected at Cormack on August 28 had seeds containing larvae of an undetermined species of seed midge. Larvae had a light yellow to white pebbled integument and possessed a sternal spatula. Most larvae were within a thin white cocoon.

Attacked seeds appeared swollen and contained no more than one midge larva. The entire embryo was destroyed.

Old Cones (Table 2)

a) Cone Beetle, Ernobius sp.

A low percentage of cones at all sites collected on every sampling date, except at Taylor's Brook on June 12, contained larvae of the cone beetle. In all infested cones only one beetle larva was present within the cone axis and there was no apparent damage to seeds. Although adults were reared in the laboratory from field-collected cones, none were found in the cones dissected. Presumably adults leave their cones soon after eclosion.

Table 2. Mean percentage (± S.E.) of three- to four-year-old black spruce cones damaged per tree by the cone beetle, Ernobius sp., at Burntberry Pond, Cormack and Taylor's Brook, Newfoundland, June-August 1984.

Location	Date of Collection	Mean percentage of damaged cones/tree ± S.E.
1. Burntberry Pond	15-VI	0.7 ± 0.5
	26-VI	0.7 ± 0.5
2. Cormack	13-VI	0.7 **
	25-VI	0.7 ± 0.5
	9-VII	0.7 ± 0.5
	23-VII	0.3*
	9-VIII	0.7 ± 0.5
	20-VIII	2.3 ± 1.3
	28-VIII	4.0 ± 1.5
3. Taylor's Brook	12-VI	-
	20-VI	1.3 ± 0.6
	10-VII	1.7 ± 1.1
	25-VII	2.0 ± 0.9
	3-VIII	1.0 ± 0.7
	15-VIII	4.7 ± 1.5
	27-VIII	2.0 ± 0.7

*Only one cone on one tree attacked.

**Two cones on one tree attacked.

2. Cone Life Study (Fig. 1)

The total number of cones produced by the 15 trees was 936 on June 8. Only 49 sound cones remained on the trees by September 5.

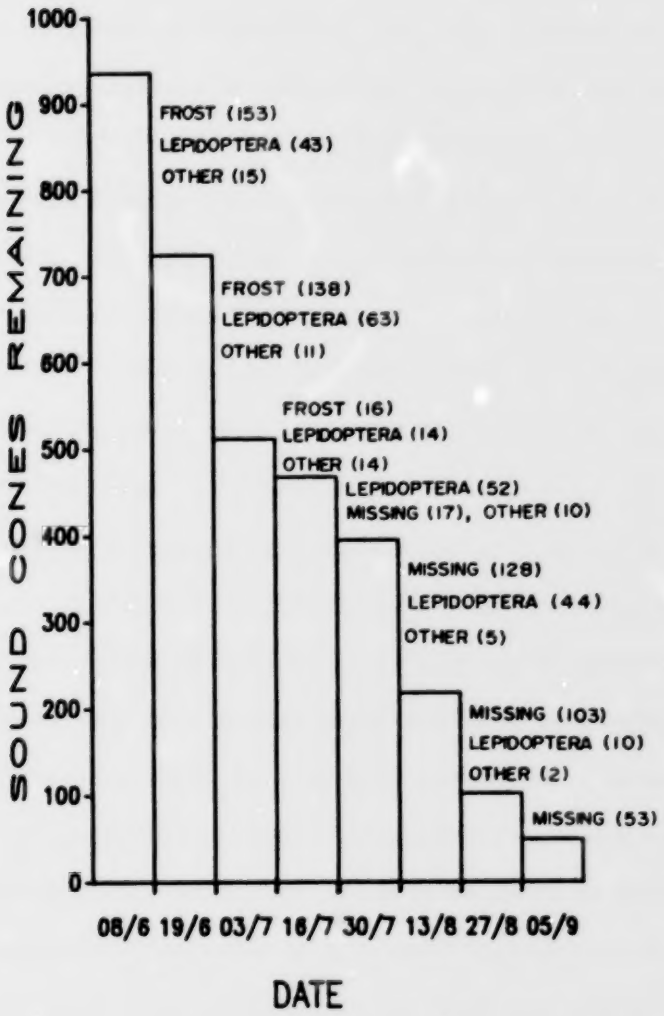

Figure 1. Seasonal decline in persistence of sound cones on 15 black spruce trees at Taylor's Brook, Newfoundland from June to September, 1984. Numbers of cones damaged or missing during each two-week interval are indicated in parentheses. Squirrels were assumed to have harvested the missing cones.

In June, cone injury was due mainly to frost[2], although damage was caused also by various Lepidoptera including the spruce budworm, orange spruce needleminer and the spruce coneworm. Seed production in the frost-damaged cones was aborted.

In July, losses in the number of sound cones declined and were primarily due to Lepidoptera, particularly the cone moth. Latent effects of frost were observed in some cones while in others, damage was caused by the cone maggot.[2]

In August and early September, attacks by the cone moth continued, however, large numbers of sound cones were missing. These losses were attributed to harvesting by red squirrels, Tamiasciurus hudsonicus (Erxleben). Although cone removal by squirrels was not directly observed, the presence of T. hudsonicus within the study area was evident. Red squirrels were seen and heard during sampling, cone-bearing branches were chewed and numerous feeding stations were found on logs and beneath black spruce trees in the area. In addition, sound cones are not easily dislodged after mid-summer and it is unlikely that any other species present at the Taylor's Brook site could have been responsible for the missing cones.

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[2]Immature cones, especially if frost-damaged, are easily dislodged during examination of cone-bearing branches. Some fell before being tagged and as a result were not counted in the "frost-damaged" category. These cones, however, were dropped from the sound cone total and placed in the "other" category. Later in the season cones with exit holes caused by the cone maggot also were placed in the "other" category.

The red squirrel is not native to insular Newfoundland but is the only species of squirrel on the island.[3] T. hudsonicus was introduced without authorization to the Great Northern Peninsula in 1963, but the Newfoundland Wildlife Division of the Provincial Government introduced it to the Notre Dame Bay area in 1964 (Payne 1976) and to the Salmonier River Valley in 1974 (Goudie 1978). All introductions have resulted in establishment of the red squirrel in Newfoundland and its range in the three areas is expected to increase (Payne 1976, Goudie 1978). No studies are examining the spread of squirrel populations in this Province at the present time.[3]

CONCLUSIONS

These studies indicate that substantial cone losses or damage can be expected in unprotected stands susceptible to attack by frost, insects and squirrels. Frost-damaged cones abort and cannot be used for seed. The extent of seed loss due to the presence of insects has not yet been determined in Newfoundland but is currently under examination by the Canadian Forestry Service. Squirrels at Taylor's Brook removed large numbers of black spruce cones in August and September at a time when cones were approaching maturity. This indicates that the red squirrel should be recognized as a potentially important pest by managers of seed crops in this Province.

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[3]Mr. D. Minty, Government of Newfoundland and Labrador, Department of Culture, Recreation and Youth (Wildlife Division).

Further research is needed to relate densities of insect pests and squirrels to cone damage and to develop pest management systems as required.

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